भारत हैवी इलेक्ट्रीकल लिमिटेड
BHARAT HEAVY ELECTRICALS LIMITED
पारेषण व्यापार अभियांत्रिकी प्रबंधन (TBEM)
नोएडा / TBG, NOIDA

DOCUMENT No.	TB-375-316-002	Rev 00	Prepared	Checked	Appd
TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	MM	SK	AS
400KV SF6 CIRCUIT BREAKER		SIGN			19/08
		DATE	18-08-15		
		GROUP	TBEM		
		W.O. No	84004		

CUSTOMER/ CONSULTANT	Gujarat State Electricity Corporation Limited, Vadodara, Gujarat/ Development Consultants Pvt. Ltd., Kolkata
PROJECTS	400kV Switchyard Extension and 400kV GIS for 1x800 MW for Wanakbori Thermal Power Station Extn. Unit-8

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Offers without checklist will not be evaluated

Rev	Date	Altered	Checked	Approved	
Distribution				To	
				Copies	

SECTION – 1

1.1 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 420 kV SF6 Circuit Breaker along with steel structure to site.

This section covers the scope and quantities of 400kV SF6 Circuit Breakers. The Specific Technical Requirements for the above item as specified by the customer (GSECL) are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification shall comprise of following sections:
Section-1: Scope, Specific Technical requirements & Quantities
Section-2: Equipment Specification
Section-3: General Technical Requirements
Section-4: Guaranteed Technical Particulars

Bidder to submit filled up **Annexure-II** attached with Section-1 confirming that there are no deviations and the offer is in full compliance with the specification.

The equipment is required for the following project:
Name of the Customer: Gujarat State Electricity Corporation Limited, Vadodara, Gujarat
Name of the Project:
400kV Switchyard (extn.) & 400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8
Name of the Customer: Gujarat State Electricity Corporation Ltd.
Name of the Consultant: Development Consultants Pvt. Ltd., Kolkata

1.2 SPECIFIC TECHNICAL REQUIREMENT

Minimum creepage for Insulators (@ 31 mm /kV)	:	13020 mm
Minimum Zinc coating on Support Structure	:	610 grams/ sq meter
Auxiliary contacts	:	Besides requirement of this spec , bidder shall wire 14 NO and 14 NC contacts for exclusive use of purchaser. Local position – 1 No. Close position – 1 No.
Number of terminals in common control cabinet	:	All contacts and control circuits ar to be wire out upto common control cabinet plus 24 terminals exclusively for purchaser's use.

Rest as per the following customer (GSECL) Specifications attached herewith:
As per section 2, TECHNICAL SPECIFICATION FOR 400KV SWITCHYARD VOLUME: IIF/1 SECTION-XV

1.3 QUANTITIES

As per Annexure-I

1.4 QUALIFYING REQUIREMENT & EXPERIENCE

The bidder shall submit the documentary evidence that equipment of similar rating has been manufactured by him and are in successful operation for more than two (2) years in two or more projects of similar nature on the date set for opening of the bid.

The Bidder shall submit along with his bid a list of major contracts for supply of similar equipment executed/being executed by him during last 5 years giving detailed particulars such as quantity, equipment rating, contract value, name of the Owner / Purchaser, year of commissioning etc.

Notwithstanding anything stated above, the customer reserves the right to assess bidder's financial and other capabilities to execute the contract. Necessary information about the financial and technical resources, organization and experience to undertake the manufacturing and supply of such equipment shall be supplied by the Bidder as an evidence of his capability for satisfaction of the Owner / Purchaser.

1.5 TESTS

1.5.1 Routine Test

During manufacture and on completion, all equipment, clamps, connectors and accessories shall be subjected to the Routine Tests as laid down in latest revision of IEC/IS.

In addition to above tests specified by IEC/IS, the following tests also have to be carried out for specific equipment:

The speed curves for EHV circuit breaker shall with the help of a suitable operation analyser to determine the breaker contact movement during opening, closing, auto-reclosing and trip-free operation under normal as well as limiting operating conditions
(Control Voltage, pneumatic pressure etc.)

1.5.2 TYPE TEST

Bidder shall submit valid type test reports of the tests as per relevant IS/IEC carried out within last **five years** from the date of LOI for BHEL i.e. **05.09.2014**.

These reports should be for the tests conducted on the equipment similar to those proposed to be

supplied under this contract and test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. These test reports shall be vetted by GSECL/DCPL/BHEL at contract stage. If any test report(s) is not acceptable by customer during contract execution stage, same has to be conducted by bidder without any commercial and delivery implication.

All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

All equipment/cables shall be of proven design and type tested as per relevant standard. Type test certificates/specific type tests shall furnished/conducted, if asked for with reference to any specific equipment in the respective sub-section of the Specification. However, bidder may note the following:

A) For short circuit test, proto-type, similar design of same capacity of higher documentary evidence shall be submitted for customer approval.

B) For new designed equipment, type test to be conducted at CPRI or Government approved laboratory at bidder's cost.

Following additional type tests reports are to be submitted for EHV circuit breaker:

a) Short line fault test
b) Out of phase making and breaking test as per IEC.
c) Rated line charging current breaking test. The breaker shall be able to interrupt the line charging current with a test voltage of 1.4 p.u. instead of 1.2 p.u. as per IEC.
d) Test to demonstrate ability to withstand 2.5 times the rated voltage across the open circuit breaker at & below lockout pressure.
e) Seismic withstand test in unpressurised condition.

Tests Witness

Tests shall be performed in presence of Owner's representative if so desired by the Owner. The bidder shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

Test Certificates

Certified reports of all the tests carried out at the works shall be furnished in requisite no. of copies for approval of the Owner.

The equipment shall be despatched from works only after receipt of Owner written approval of the test reports.
Type test certificate on any equipment, if so desired by the Owner, shall be furnished.
Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.

1.6 INSPECTION & TESTING

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment and accessories in accordance with the applicable IEC /IS and the material shall be offered for final inspection by BHEL and GSECL in accordance with quality assurance plan.

1.7 QUALITY PLAN

The contractor shall carry out the works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.
Attached Manufacturing Quality Assurance Plan (MQP) format in Section-3 shall be followed.

1.6 Sub-vendor list

Sub-vendor list for Circuit breaker shall be as per Annexure-III

Sl.No.	Description	Unit	Quantity
	MAIN EQUIPMENT		
1	420 KV, 2000 A, 40 kA for 3 sec , class M1-C1-E1 3-phase SF6 Circuit Breakers without PIR, Pneumatic/Electrically Spring Charged/Electro-Hydraulic mechanism with single and three phase high speed auto reclosing alongwith common control cabinet, support structure , fixing bolts, cable glands and other accessories, complete in all respects.	Nos.	6
2	SF6 gas 20% of total quantity used for 6 nos. Circuit breakers	lot	1
	SUPERVISION		
3	Supervision of Erection ,Testing & Commissioning of 420kV Breakers with special tools and test instruments* in Bidder scope	Nos.	6
	MAINTENANCE EQUIPMENT		
4	SF6 Gas Filling and Evacuating Device (Portable) with necessary gas valves, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc.	Set	1
5	OPERATION ANALYSER WITH DCRM KIT: Operational analyser to record contact travel, speed and for making measurement of Operating timings, synchronisation of contacts in one pole or all poles.	Set	1
6	Portable SF6 Gas Leak Detector	Nos.	2
7	SF6 GAS FILLING ATTACHMENT (OF EACH TYPE)	Set	1
	MANDATORY SPARES		
8	Closing Coil	Nos.	2
9	Tripping Coil	Nos.	2
10	SF6 Gas Pr. Switch	Nos.	1
11	Seals, Gaskets and Accessories	Sets	2
12	Spare SF6 Cylinder (50 kg)	Nos.	1
13	SF6 Gas leakage detector	Nos.	1
14	Kit for Hardware	Nos.	1

Note:

1. Maintenance equipment (sl. No. 4 to 7)will be of reputed make and subject to customer approval
2. Each 400kV Circuit Breaker shall be supplied with accessories as per ANNEXURE-B.
3. Any other accessory/device required for the satisfactory operation of the breaker.
4. The testing and commissioning shall be inclusive of the following:
   a) Testing equipment required for testing.
   b) To and Fro fares from Bidder's headquarter to BHEL site.
   c) Accommodation and conveyance at site.

d) Any other incidental charges.

No other charges shall be paid by BHEL.

5 '*' - The following instruments/kits shall be brought out at site by Bidder/supplier:

(a) Time Interval meter (Timing kit)

(b) Gas leak Detector

(c) 1 set of adopter/transducer for analyzer for 420kV SF6 Circuit Breaker.

(d) 1 set of Gas filling adaptor for 420kV SF6 Circuit Breaker.

6 The following instruments/kits shall be provided by BHEL at site:

i) Circuit Breaker Analyzer- (Make- SCOPE T&M HISAC 2406) -
Adaptor/Transducer for above Analyzer suitable for your Breaker shall be in scope of bidder.

ii) DCRM

iii) Dew Point Meter

iv) Megger

v) Multimeter

ANNEXURE-II

It is confirmed that there are no deviations and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and/ or exceptions. Further it is confirmed that at all drawings / data sheets/QP/ type tests reports shall be submitted to BHEL for organising approval of ultimate customer. Also, furnishing of all relevant information / repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL & without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation_____

Place_____

Date _____

Company seal

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	ELECTRICAL	
1	Protective Relays	ABB, JYOTI, SIEMENS, ESSUN & RAY, ROLLE , GEC, ALSTOM, L&T, CSEG, MAKE OF MAIN PROTECTIVE RELAY SHALL BE RESTRICATED TO AREVA/ABB/ SIEMENS AS PER NIT.
2	AUXILIARY RELAY	BCH,GEC, ALSTOM, L&T, SIEMENS,ABB
3	OVER LOAD RELAY/ THERMAL OVER LOAD RELAY	L&T, SIEMENS, TELEMECHANIQUE & CONTROLS, ABB, BCH,CGL, SCHNEIDER, SPACEAGE-HYUNDAI
4	PROTECTIVE RELAY/ MOTOR PROTECTION RELAY	ABB, ALSTOM, GEC, EASUN, Siemens, Areva
5	TIMER/ AUXILIARY CONTROL RELAY	ABB, BCH, GEC,L&T, ALSTOM,SIEMENS, TELEMECHANIQUE & CONTROLS.
6	INTER POSING RELAY FOR COMMANDS O/P TO MCC	JYOTI, H&B, GEC, ALSTOM, OEN , OMRON, HONEYWELL ENGLISH ELECTRICAL,SIEMENS ,ABB
7	MCCB	GE, HAVELLS, MDS, L&T, SIEMENS, STANDARD, SPACE AGE, HUNDAI, SCHNEIDER, CGL, NGEF, ALSTOM, CONTROL & SWITCHGEAR CO. LTD.
8	MCB	CGL, GEC, ALSTOM, HAVELLS, MDS, L&T, SIEMENS,STANDARD, SCHNEIDER, NGEF, ABB
9	FUSES & FUSES SWITCH ON / OFF SWICHES /HRC FUSES WITH BASE	GEC, ALSTOM, L&T, NGEF, SIEMENS, COOPER BUSMAN, EE, STANDARD
10	SWITCH SOCKET OUTLET INDUSTRIAL	BCH, BEST & CROMPTON, CGL, GEC, REY ROLLE, BARN, ANCHOR.
11	AMMETER & VOLTMETER	AUTOMATIC ELECTRIC,ABB,IMP, MECO, L&T, RISHAB, SILKANS
12	METAL CLADE PLUG & SOCKET(INCLUNIND WELDING SOCKET)	BCH, BEST & CROMPTON, CGL, EE, REY ROLLE, BARN, EASUN

SR. NO.	DETAILS OF EQUIPMENT/SYSTEM	FINAL APPROVED VENDOR
	ELECTRICAL	
13	LT AC Motors	ABB, CROMPTON GREAVES, ALSTOM INDUSTRIAL, GEC, KIRLOSKAR ELECTRIC CO;NGEF, JYOTI, SIEMENS, BHARAT BIJLEE LTD; LG , TOSHIBA, ANSALDO, GE, MELCO, MARATHON , BHEL
14	LT AC Geared Motors	GEC, ALSTOM, KIRLOSKER, ELECTRIC CO.
15	DC Motors	GE-USA OR EQUIVALENT ALSTOM LTD/BHEL/ CROMPTON GREAVES LTD./GE/ KIRLOSKAR ELECTRIC CO. LTD. , SIEMENS / MELCO/ ABB
16	CONTROL/ SELECTOR SWITCH	BCH, GEC, ALSTOM, JYOTI, KEYCEE, RECOM, RICO, SWITRON, ABB, L&T, SIEMENS, KROUS-NAIMER SALZER
17	PUSH BUTTONS	BCH,GEC, ALSTOM, L&T, TELKNIC, SIEMENS, VAISHNO, RASS CONTROL
18	TERMINAL BLOCK	CONNECTWELL, ELEMAX, TECHNOPLAST , TOSHA, VINPAR, PHOENIX, WAGO
19	415 V / 3 PHASE/ AC SQ . INDUCTION MOTOR	KIRLOSKAR, BBL, SIEMENS, ABB CROMPTON, GE,MARATHON,ALSTOM
20	LIGHTING PANEL AND PUSH BUTTON STATIONS	HENSEL,Siemense,Havell's,Bajaj, Philips,L & T,
21	CONTROL PANEL, CONTROL DESK, AUXILIARY PANEL & INDICATING DESKS	ABB, BEST & CROMPTON , ELEMECH, GEC , ALSTOM , NIRMAL , NGEF, OSAKA , SIEMENS , TLK, EASUN REYROLL, ELPRO, L&T, PYRO TECH , PROCON , RITTAL, BELLS, FOX BORO , ILK, APW, PECON
22	MOSAIC GRIDS	SUB-KLEW – GERMANY,SIEMENS – GERMANY ,SYMO - SWITZERLAND/PYROTECH, ICA
23	AC To DC Convertor	PHOENIX, SIEMENS, COSEL-GERMANY

Note: Make of any other equipments / item / components not specified in the above list shall be subject to the approval of Purchaser.

SECTION 2

1.1 SPECIFIC TECHNICAL REQUIREMENT

As per the following customer (GSECL) Specifications attached herewith:

As per section 2, TECHNICAL SPECIFICATION FOR 400KV SWITCHYARD VOLUME: IIF/1 SECTION-XV (13+3 sheets).

ANNEXURE-B

FITTINGS & ACCESSORIES

A. **Circuit Breaker**

A.I Each Circuit Breaker shall be furnished complete with fittings and accessories as listed below :

1. Operating mechanism complete with all accessories, fittings and double tripping coils and closing coil, pole discrepancy feature and low pressure blocking device etc. as required.
2. Complete SF6 gas system along with valves, pressure switches, pressure gauges, SF6 gas density monitor, etc.
3. Various attachments & accessories for gas filling.
4. Two ground pads per pole suitable for termination of 75 x 10 mm M.S. flats.
5. Base frame and anchor bolts and nuts.
6. Set of valves, pressure gauges and pressure switches as required.
7. Auxiliary contacts and relays.
8. LOCAL/REMOTE Selector switch, TRIP/CLOSE Push Buttons.
9. Manual tripping devices with protective flap.
10. Mechanical ON-OFF indicator.
11. Operation counters.
12. Weatherproof outdoor type control cubicle and pole boxes having IPW55 enclosure.
13. Set of switch fuse units/MCCB for A.C. and D.C. supply.
14. Space heater with thermostat and ON-OFF switch.
15. Cubicle illumination lamp with ON-OFF switch.
16. 3 Pin 5A Socket with ON-OFF Switch.
17. Terminal blocks and internal wiring - lot as required.
18. Set of pre-fabricated copper pipe with fittings, clamps, and hardware for connection between control cubicle and pole boxes as required.
19. Interconnecting wires, G.I. conduits and accessories for connection between control cubicle and pole boxes.
20. The gas filling and internal pressure monitoring devices per pole for SF6 breakers.
21. Other standard accessories which are not specifically mentioned but supplied with breakers of similar type and rating for efficient and trouble-free operation.
22. First filling of SF6 gas along with 20 % additional for the complete lot in non returnable container.
23. ~~Bimetallic terminal connectors (Suitable for Al tube / ACSR / AAC – Horizontal / vertical)~~
24. Supporting galvanized steel structure.

switches, earth switches etc.

Following analogue signals of all bays shall be made available in the interface panel for SAS/DCS thru' transducers:

- Line currents of each phase

- Line Voltage of each bus
- MW

- MVAR

- PF

Two numbers potential free contact of each of the following equipment shall be made available for SAS/DCS in the interface panel:

- Circuit breaker

- Disconnecting switch

- Earth Switch

3.03.05 Protection of 400kV lines; and 400kV bus bar shall be effected through numerical/microprocessor based digital protection relays.

3.03.07 Provision shall be made for transferring major data of the Switchyard protection and metering system to the main plant DCS / GIS SCADA of 800MW unit.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Circuit Breaker**

4.01.01 Each circuit breaker shall be furnished complete with :

i) Fittings and accessories.
ii) Auxiliary equipment.
iii) First filling of SF6 gas plus 20% spare.

The equipment will be used in the switchyard having characteristics as listed in the Annexures.

The equipment will be installed outdoor in a hot, humid and tropical atmosphere.

All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

There shall be no radio interference when the equipment is operated at

maximum service voltage.

The safety clearances of all live parts of the equipment shall be as per relevant standards.

Corona shall be reduced to the minimum as per relevant standard by using suitable devices.

The safety clearances of all live parts of the equipment shall be as per relevant standards.

The equipment shall be capable of withstanding the dynamic and thermal stresses of listed short circuit current without any damage or deterioration.

4.01.02 Type and Duty

The circuit breaker shall be three-pole, sulphur hexafluoride (SF6) type, having internal isolation without any sequential interlock.

The circuit breaker shall be restrike free as per IEC under all duty conditions and shall be capable of performing their duties without opening resistors.

The duty of the circuit breaker shall involve satisfactory interruption of short circuit currents as listed in the annexure.

The breaker shall be suitable for operation even under condition of "phase opposition" arising out of faulty synchronisation.

The breaker shall be capable of clearing the "Kilometric" fault of same magnitude as rated short-circuit current.

The breaker shall be capable of interruption of low reactive currents (lagging/leading) without undue over voltage.

Breakers with multi-break interruptions shall be so designed that the voltage developed across a pole is uniformly distributed over the power breaks.

The circuit breaker shall be capable of :

i) Interrupting line/cable charging current as per IEC without any restrike and without use of opening resistors.

ii) Clearing short line fault (kilometer faults) with source impedance behind the bus equivalent to symmetrical fault current specified.

iii) Breaking 25% of the rated fault current at twice rated voltage under phase opposition condition.

4.01.03 Constructional Feature

The circuit breakers shall comprise three identical single pole units linked together either electrically, pneumatically or electro hydraulically. Each breaker pole shall have its associated mechanism box. Common operating shaft for all the three poles shall not be acceptable.

Breaker shall be furnished with first charge of SF6 gas, plus 15% additional quantities of SF6 gas required for complete lot.

The SF6 gas shall be supplied in properly treated steel cylinder of adequate strength. Chemical analysis of gas supplied shall be furnished for Owner's reference.

SF6 breaker shall have proper sealing to prevent entry of moisture inside. Further it shall incorporate devices to absorb any moisture, which may exist within breaker units after assembly and gas charging. These devices shall be so located as to permit easy removal/replacement.

Each pole shall form an enclosure filled with SF6 independent of the two other poles, the pressure of each pole shall be monitored and regulated by individual temperature compensated gas density monitor (indicating type) and pressure switches. Single 'O' ring seals shall be provided on each static joint. The density monitor shall meet the following requirements.

i) It shall be possible to dismantle the density monitor the checking/ replacement without draining the SF6 gas by using suitable interlocked non-return coupling.

ii) The monitor shall damp the pressure pulsator while filling the gas in service so that the flicking of the pressure switch contacts does not take place.

iii) A pressure indicator shall be provided.

iv) The alarm and trip setting shall be provided such that advance warning can be given for low pressure below and acceptable level and after alarm, the breaker shall open, if the pressure falls below pre-determined value.

The circuit breaker shall have proper sealing so that leakage of gas outside is not more than 1% per annum under all conditions of operation. Further, it shall incorporate devices to absorb any moisture, which may exist/be released within breaker poles after assembly, gas charging and during operation.

The operating rod connecting the operating mechanism to the arc chamber (SF6 media) shall have adequate seals. All gasketted surfaces shall be smooth, straight and reinforced, if necessary, to minimize distortion and make a tight seal

The circuit breaker units shall be complete with associated valves, piping, gauges, pressure switches, seals, lubricants and other accessories/materials to ensure their proper assembly and functioning.

The circuit breaker shall be provided with terminal pads of adequate size for connection to Rigid Aluminum tube by expansion type terminal connector. Adequate transversal and vertical force shall be considered for the terminals so as to support the interconnecting tubes spanning around 10 meters during short circuit and wind force.

Line breakers will have three (3) identical single pole units linked together

electrically and will have single phase and three phase auto-reclosing facility. GT and ST bay circuit breakers will have three (3) identical single pole units mechanically ganged and actuated by a single operating mechanism.

4.01.04 Main Contacts and Arc Quenching Chamber

i) The main contacts shall have adequate area and contact pressure for carrying rated continuous and short time current without excessive heating liable to cause pitting and welding. Contacts shall be permanently under pressure of SF6 gas.

ii) If multi-break interrupters are used, they shall be so designed and augmented that a uniform voltage distribution is developed across them.

iii) The tips of the arcing and main contacts shall be heavily silver-plated.

iv) The contacts shall be adjustable to allow for wear, shall be easily replaceable and shall have minimum movable parts and adjustments.

v) Main contacts shall be first to open and last to close so that there will be little contact burning and wear.

vi) Arcing contacts shall be first to close and last to open and shall be easily accessible for inspection and replacement.

vii) The arc quenching device shall be of robust construction and shall not require any critical adjustment. The devices shall be easily accessible and removable for access to the breaker contacts.

4.01.05 Accessories and Attachments

i) Circuit breaker operation analyser shall be provided.

ii) Necessary provision shall be made in the circuit-breaker for attaching an operational analyser to it after its installation at site to record contact travel, speed and for making measurement of operating timings, pre-insertion timing of closing resistors, synchronisation of contacts in one pole or all poles.

iii) The SF6 gas density monitor shall be dial type and properly temperature compensated. The density monitor shall meet the following requirements:

a) It shall be possible to dismantle the density monitor for checking/replacement without draining the SF6 gas by using suitable interlocked non-return valve coupling.

b) It shall damp pressure pulsation while filling the gas in service so that flickering of the pressure switch contacts does not take place.

iv) All piping with associated valves; fittings, clamps & hardware shall be furnished to make the operating mechanism system specified above complete in all respects. Pipes shall be solid drawn copper tubes of

adequate size to reduce the pressure drop to a minimum. Pipe bend shall be made by cold bending. Pipe joints shall be compression type. Solder type pipe joints/connections are not acceptable. All horizontal pipes shall run with a minimum slope of 1:100. At the lowest point a drain valve shall be provided. Pipes shall be normally laid along trench wall keeping provision for expansion loop.

v) A Portable SF6 gas filling and evacuating system shall be supplied with necessary gas valves, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc.

vi) The sensing probe of SF6 gas leaked detector shall be able to reach all the points on the breaker where leakage is to be sensed. The accuracy of the equipment shall be at least 10 ppm. It shall be free from induced voltage effect.

4.01.06 Auxiliary Contacts

i) The auxiliary switches required for satisfactory operation of the circuit breaker including auto reclosing (Single shot, single and 3 phase) ON/OFF indicators both in control room and switchyard, discrepancy switch in the mimic diagram in the control room and antipumping features shall be provided on each circuit breaker. In addition, each breaker shall be provided with six (6) normally open and six (6) normally closed electrically separate spare auxiliary contacts, in addition to those required for its own operation and indication.

ii) The auxiliary contacts shall be convertible type so that normally open contacts can be converted into normally close contact & vice-versa at site.

iii) The auxiliary contacts shall be rated 10A at 240 V A.C. and 2A at 220 V D.C with circuit time constant of at least 20 millisecond.

4.01.07 Control & Interlock

i) All electrical and mechanical interlocks which are necessary for safe and satisfactory operation of the circuit breaker shall be furnished. Breaker operation shall be locked in case of low SF6 gas pressure and low air pressure at preset values. Alarms shall be provided for low gas pressure and low air pressure at values higher than lock-out pressure of SF6 gas and air. It is intended that before lock-out occurs, the breaker shall be in trip position.

ii) The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

iii) Each breaker pole shall be provided with two (2) independent tripping circuits, valves, pressure switches and coils each connected to a different set of protective relays.

iv) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. Provision shall be made for local electrical/local manual control. For this purpose,

local/remote selector switch, close & trip control switch, auxiliary relays, indication lamps etc. shall be provided in the control cabinet for the breaker.

v) The trip coils shall be suitable for trip circuit supervision during both open and close positions of the breaker. The trip circuit supervision relay would be provided in the remote control panel. Necessary terminals shall be provided in the control cubicles.

Gas analyser contacts, pressure switch contacts, etc. shall be suitable for direct use as permissive in closing, tripping, annunciation and control circuits. DC supplies for all auxiliary circuits shall be monitored and provision shall be made for remote annunciations.

4.01.08 Insulators

i) Insulator shall be wet-process porcelain, brown glazed and free from all blemishes. Metal parts and hardware shall be hot-dip galvanised.

ii) Insulator shall have adequate mechanical strength and rigidity to withstand the duty involved.

iii) When operated at maximum system voltage, there shall be no electrical discharge. Shielding rings, if necessary, shall be provided.

iv) Insulation shall be coordinated with basic impulse level of the system. The creepage distance shall correspond to heavily polluted atmosphere.

v) All routine tests shall be conducted on insulators as per IEC233/ relevant IS in addition to the following tests :

a) Ultrasonic test.

b) Pressure test.

c) Bending load test in four directions at 50% specified bending load.

d) Bending load test in four directions at 100% specified bending load as acceptance test of lot.

e) Burst pressure test as a sample test.

vi) The insulator porcelain shall be in one integral place in green and fired stage. No jointed porcelain is acceptable.

4.01.09 Operating Mechanism

i) Operating mechanism shall be stored energy type, with motor operated spring – spring charged closing mechanism. Anti-pumping and trip free features complete with 2x100% shunt trip coils shall be provided. The mechanism of the breaker shall be such that the position of the breaker is maintained even after leakage of operating media and/or gas.

ii) The operating mechanism shall be suitable for high speed reclosing (single phase and three phase). It shall be anti-pumping and trip free (as per IEC definition) electrically and either mechanically or pneumatically under every method of closing (except during manual closing of a breaker for maintenance). A latch checking switch shall be provided on mechanically trip free mechanism to prevent reclosure before the breaker latches have reset.

iii) There shall be no objectionable rebound and the mechanism shall not require any critical adjustment. It shall be strong, rigid, positive and fast in operation.

iv) The operating mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operated closing devices.

v) Mechanical indicator shall be provided to show open and close positions of each pole of the circuit breaker. It shall be located in a position where it will be visible to a man standing on the ground. An operation counter at 1000-1300 mm level shall also be provided. The counter readings shall be visible from the ground even with the mechanism housing closed.

vi) Closing coil and trip coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. If additional elements are introduced in the trip coil circuit, their successful operation for similar applications on outdoor breakers shall be clearly brought out in the appropriate schedule.

vii) The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons.

viii) Each breaker pole shall be provided with two (2) independent tripping circuits, valves, pressure switches and coils each connected to a different set of protective relays. The trip coils shall be suitable for trip circuit supervision during both open & close positions of the breaker.

ix) Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by trip coils. Provision shall be made for local electrical control. "Local/Remote" selector switch and closing and trip push buttons/control switch shall be provided in the breaker control cabinet. In addition local manual trip button shall be provided.

x) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

xi) All three broken poles shall operate simultaneously. Pole discrepancy feature shall be provided to trip the broken out if all the poles do not close simultaneously within the stipulated time.

4.01.10 Pneumatically Operated Mechanism

Each pneumatic operated breaker shall be equipped with compressed air system comprising compressor, air receiver, necessary piping and valves,

control equipment etc. to maintain the air pressure at the air receiver between operating limits.

Each air receiver shall be of sufficient capacity to allow one complete duty cycle of the breaker without running of compressor.

Independently adjustable pressure switches with potential free, ungrounded contacts to actuate a lock out device shall be provided. This lockout device with provision of remote alarm indication shall be incorporated in the circuit breaker to prevent operation whenever the pressure of the operating mechanism is below that required for satisfactory operation of the circuit breaker. The scheme should permit operation of all blocking and alarm relays as soon as the pressure transient present during the rapid pressure drop has been damped and a reliable pressure measurement can be made. Such facilities shall be provided for following conditions :

i)	Trip lockout pressure	-	2 Nos.
ii)	Close lockout pressure	-	1 No.
iii)	Auto reclose lockout pressure	-	1 No.
iv)	Extreme low pressure	-	1 No.

Each compressor shall have sufficient capacity to charge air receiver to the following service schedule:

i) From minimum operating pressure to maximum operating pressure within 5 minutes of operation.

ii) From atmospheric pressure to maximum operating pressure within 15 minutes of operation.

iii) Normal running air-charging time for the compressor shall not exceed 15 minutes considering 10% leakage/day

The compressor shall be furnished complete with suction filter, after-cooler, drive motor, starter, controls and other accessories. All starters, switches, fuses and other accessories shall be housed in a pedestal mounted sheet steel control panel. The compressor motor shall be suitable for direct on line starting, both manually and automatically through pressure switch contacts. The pressure switch contacts shall be easily adjustable within reasonable limit. The compressor motor shall be capable of starting against any backpressure in receiver or pipelines.

Each receiver shall be provided with safety valve to protect the pneumatic system against abnormally high pressure and drain valve to drain any water or oil in the receiver.

The flow capacity of the safety valve connected to the air receiver shall be 20% higher than the total compressor capacity. The safety valve connected after the reducing valve shall have sufficient flow capacity so that the pressure on the secondary side can never exceed the highest permissible pressure even when the reducing valve becomes locked in fully open position for any reason. The reducing valves shall preferably be diaphragm type.

Reducing valves, non-return valves, etc. must be of such type that more sensitive parts would not be exposed to accumulation of water or dust.

The compressed air mechanism shall be capable of operating the circuit breaker under all duty conditions with the air pressure immediately before operation between 85% and 110% of the rated supply pressure. The make/ break time at this supply pressure shall not exceed the specified make/break time within any value of trip coil supply voltage as specified.

4.01.11 Spring operated mechanism

Spring operated mechanism shall be complete with motor, opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.

After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.

Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it requires not more than 30 seconds for full charging of the closing spring.

Closing action of circuit breaker shall compress the opening spring ready for tripping.

When closing springs are discharged after closing a breaker, closing springs shall be automatically charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition. Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is already in the closed position.

The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

4.01.12 Hydraulically Operated Mechanism

Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor, etc. One number hand pump set shall also be provided for emergency operation of the circuit breaker.

The hydraulic oil used shall be fully compatible for the specified temperature range.

The oil pressure switch controlling the pump and pressure in the high pressure reservoir shall have adequate number of spare contacts to be used for continuous monitoring of low pressure, high pressure etc.

The mechanism shall be suitable for one complete duty cycle of the breaker after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto-reclosure duty.

The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up. The opening time at the lowest pressure for a particular operation shall not exceed the guaranteed operating time within any value of trip coil supply voltage as specified.

Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of Nitrogen shall be provided.

All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage at a minimum of 1.5 times maximum working pressure.

4.01.13 Sulphur Hexafluoride (SF6) Gas

i) The SF6 gas shall be new and comply with relevant IEC/IS and shall be suitable in all respects for use in the circuit breakers under the various operating conditions.

ii) SF6 gas shall be tested for quality, dew point, air, hydrolysable fluorides and water content as per IEC quoted above and test certificates shall be furnished covering all tests for each lot of SF6 gas. Further site test for moisture and air content to be done prior to commissioning of the breaker.

iii) The high-pressure cylinders in which SF6 gas is shipped and stored at site shall comply with requirements of the following standards and regulations : IS-4379, IS-7311

The cylinders shall also meet Indian Boiler Regulations.

4.01.14 Control Cubicle

i) A common control cubicle shall be furnished to house electrical, controls, monitoring devices and all other accessories except those, which must be located on individual poles.

ii) The cubicle shall be IP-55, of gasketted weatherproof construction, fabricated from sheet steel minimum 2 mm thick.

iii) The cubicle shall have front access door with lock & keys and removable gland plate at the bottom.

iv) Thermostat controlled space heater, internal illumination lamp and 3-pin 5A socket with individual ON-OFF switches shall be provided in

the cubicle.

v) For local operation, following shall be provided :

a) LOCAL/REMOTE selector switch.
b) TRIP/CLOSE push buttons.

vi) All electrical, pneumatic connections between the control cubicle and individual poles shall be furnished.

4.01.15 Wiring

i) Wiring shall be complete in all respects to ensure proper functioning of the control, protection, monitoring and interlocking schemes.

ii) DC circuit for trip coil 1 & 2 shall be wired separately so as to connect with duplicate DC supply.

iii) Wiring shall be done with flexible 650/1100V grade, PVC insulated, switchboard wires with 2.5 mm² stranded copper conductor. Wiring between individual poles and control cubicle shall be routed through rigid G.I. conduit or / and metallic flexible conduits.

iv) Each wire shall be identified at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram. AC/DC wiring shall have separate colour-coding.

v) Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

vi) All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.

4.01.16 Terminal Blocks

i) 650V grade, multi way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm2 stranded copper conductor and provided with acrylic insulating cover.

ii) Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Separate terminal blocks shall be used for AC/ DC wiring termination.

iii) Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

iv) Terminal blocks used for interface with DCS via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

4.01.17 Piping and Accessories

All piping with associated valves; fittings, clamps and hardware shall be furnished to make the operating mechanism system specified above complete in all respects. Pipes shall be solid drawn copper tubes of adequate size to reduce the pressure drop to a minimum. Pipe bend shall be made by cold bending. Pipe joints shall be compression type. Solder type pipe joints/ connections are not acceptable. All horizontal pipes shall run with a minimum slope of 1:100. At the lowest point a drain valve shall be provided. Pipes shall be normally laid along trench wall keeping provision for expansion loop.

4.01.18 Support Structures

The equipment shall be supplied with all support structures, which are integral part of the breaker. All support structure shall be hot dip galvanised with minimum 610 gram/sq.mtr. net of zinc after full chemical treatment as per relevant standard.

4.01.19 Auxiliary Equipment

A Portable SF6 gas filling and evacuating system shall be supplied with necessary gas valves, safety devices, gas purity monitoring devices, regulators, vacuum pump, pressure gauges/switches, hose pipes etc.

The sensing probe of SF6 gas leaked detector shall be able to reach all the points on the breaker where leakage is to be sensed. The accuracy of the equipment shall be at least 10 ppm. It shall be free from induced voltage effect.

An Operational Analyzer shall be supplied to record contact travel, speed and for making measurement of operating timings, synchronization of contacts in one pole or all poles.

4.01.20 Support Structures

The equipment shall be supplied with support structures, which are integral part of the breaker.

All support structure shall be hot dip galvanized with minimum 610 gram/sq.mtr. net of zinc after full chemical treatment as per relevant standard.

The height of the support structure shall be decided based on, whichever is higher, of the following:

a. The minimum vertical distance from the bottom of lowest porcelain part of the bushing shall be at least 2440 mm from top of the plinth level of the foundation.

b. The height of the lower terminal pad at the specified elevation above the plinth level.

The design of the structure shall be submitted for approval.

4.01.21 Name Plate

Each circuit breaker and its operating devices shall be provided with nameplate clearly marked the particulars in accordance with IEC.

The nameplate shall be provided in visible portion of normal service and installation.

4.02.00 **400kV Disconnecting Switch**

The equipment will be used in the switchyard, having characteristics as listed in the Annexures.

Each disconnect switch shall be furnished with fittings and accessories as listed in the Annexures.

Disconnect switches shall be suitable for connection to string conductor / tube bus of required no. & size.

The equipment will be installed outdoor in a hot, humid and tropical atmosphere.

All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

The maximum temperature in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

The equipment shall be capable of withstanding the dynamic and thermal stresses of listed short circuit current without any damage or deterioration.

There shall be no radio interference when the equipment is operated at maximum service voltage.

The safety clearances of all live parts of the equipment shall be as per relevant standards.

Corona/grading ring as required shall be provided.

4.02.01 Type and Duty

a) The disconnect switch shall carry rated current continuously and short-time current for 3 second.

b) In addition, the disconnecting switch shall be capable of making and breaking -

   i. Magnetizing current of the voltage transformer.

   ii. Capacitive current of the buses and short connections.

4.02.02 Constructional Features

The 3-pole disconnect switch shall be gang operated type so that all the poles make and break simultaneously. 1-pole disconnect switch shall have individual pole drive.

The disconnect switch shall be designed for upright mounting on steel structure unless otherwise indicated.

ANNEXURE-A

RATINGS AND REQUIREMENTS

1.0	CIRCUIT BREAKER		
1.1	Type	:	Outdoor, SF6
1.2	Service	:	Outdoor
1.3	Pole	:	3 – Single Pole
1.4	Rated Voltage	:	420 KV_{rms}
1.5	Rated Frequency	:	50Hz, +3% to -5%
1.6	System Neutral Earthing	:	Effectively grounded.
1.7	Standard to be followed	:	IEC-62271-100, 60694, IS-12729
1.8	Class		
1.8.1	Mechanical Endurance Class	:	---------- M1----------
1.8.2	Electrical Endurance Class	:	---------- E1 ----------
1.8.3	Restrike Probability Class	:	---------- C1 ----------
1.8.4	Electromagnetic Compatibility(EMC)	:	— as per IS 12729 /IEC 60694— normal severity class
1.9	Rated Insulation Level		
1.9.1	Rated Lightning Impulse withstand voltage KV_{peak}		
	a) between phase to earth	:	1425
	b) between phases to CB open	:	1425
	c) across isolating distance (impulse on one terminal and other terminal earthed)	:	1425 (+240) *
1.9.2	Rated Switching Impulse withstand voltage KVpeak		
	a) between phase to earth	:	1050
	b) between phases	:	1575
	c) across isolating distance	:	900 (+345) *

Note: * Figures given in the bracket () are peak value of the power frequency to be applied to the opposite terminal (across isolating distance)

1.9.3	Rated one minute Power Frequency withstand voltage KV_{rms}		
	a) across isolating distance	:	610
	b) To earth & between poles	:	520
1.10	Corona extinction voltage (KV rms)	:	320 (min)
1.11	Maximum radio interference Voltage at 1.1Urated /sq.rt.3 (Micro volt)	:	Less than 1000
1.12	Temperature rise		
1.12.1	Design Ambient Temperature °C	:	50
1.12.2	Limit of temperature rise	:	Per IS/IEC duly adjusted for site condition
1.13	Rated Normal Current at 50°C ambient	:	2000 A
1.14	Rated Making & Breaking Capacity		
	i) Short-circuit breaking current (Symm):		40 kA_{rms}
	ii) Percentage D.C. component	:	as per IEC 62271-100
	iii) Rated short-circuit making current	:	100 KA_{peak}
	iv) Rated peak withstand current	:	100 KA_{peak}
	v) Rated short time withstand current	:	40 KA for 3 sec
	vi) Out of phase breaking current	:	10 KA
	vii) Out of phase making current	:	40 KA
	viii) Rated line charging breaking current:		400 A_{rms}
	ix) Characteristic for short line fault related to rated short circuit breaking current:		as per IEC 62271-100
	x) Rated capacitive switching breaking current/inrush making current	:	400 Arms /20 KApeak
	xi) TRV Characteristics	:	as per IEC 62271-100
1.15	First pole to clear factor	:	1.3
1.16	Rated Terminal Load	:	As per IEC 62271-100 or calculated value which one is higher
1.17	Noise level at base	:	Maximum 140dB at base of circuit breaker
1.18	Mounting	:	Hot Deep Galvanised Steel structure
1.19	Minimum Creepage distance (@31 mm/KV)	:	13020 mm
1.20	Phase to phase clearance	:	7000 mm
1.21	Operating mechanism	:	Pneumatic/spring/hydraulic/or a combination of these

1.22	Opening time	:	Not more than 40 miliseconds
1.23	Closing time	:	Not more than 100 miliseconds
1.24	Auto reclosing	:	Single phase and 3 phase auto reclosing for line breakers.
1.25	Operating Duty	:	0 - 0.3"-CO-3'-CO
1.26	SF6 Gas	:	As per IEC 60376 & 61634
1.27	Auxiliary Voltage		
	i) Closing	:	220 (+ 10%/-15%) V D.C.
	ii) Tripping	:	220 (+ 10%/-30%) V D.C.
	iii) Spring Charge Motor	:	240 V, 1 Ph, 2W, 50 Hz
	iv) Compressor/Pump Motor	:	415V, 3 Ph, 3W, 50Hz
	v) Heater/Lamp/Socket	:	240V, 1 Ph, 2W, 50Hz
1.28	Anti pumping	:	Required
2.0	DISCONNECTING SWITCH		
2.1	Type	:	Motor operated, horizontal centre break type
2.2	Service	:	Outdoor
2.3	Pole	:	3
2.4	Rated Voltage	:	420 KV_{rms}
2.5	Rated Frequency	:	50Hz, +5% to -5%
2.6	System Neutral Earthing	:	Effectively grounded.
2.7	Reference Standard	:	IEC 60129 / IS 9921
2.8	Rated Insulation Level		
2.8.1	Rated Lightning Impulse withstand voltage KV_{peak}		
	a) across isolating distance	:	1425 (+240)*
	b) to earth & between poles	:	1425
2.8.2	Rated Switching Impulse withstand voltage KV_{peak}		
	a) across isolating distance	:	900 (+345)*
	b) between phase to earth	:	1050
	c) between phases	:	1575

SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification. The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Gujrat State Electricity Corporation Ltd. Vadodara
b)	Consultant	Development Consultants Pvt. Ltd., Kolkata - 700 091
c)	Project Title	400kV Switchyard Extension and 400 kV Switchyard for GIS for 1x800 MW Supercritical Thermal Power Project
d)	Location	Wanakbori is connected with roads by the National Highway, NH-8 (about 10 km from plant -Dakor-Godhra) and state highway SH-59 (about 2 km from plant -Balasinor- Sevalia). Wanakbori is connected with railways by Ahmedabad-Vadodara main Broad Guage line of Western Railway (about 8 km from Sevalia). Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
e)	Elevation above MSL	72.0 meters
f)	Transport Facilities	Road/Rail, Nearest railway station is Sevalia. Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
g)	Postal Address	To follow
METEOROLOGICAL DATA OF SITE IS GIVEN BELOW		
a)	Max. daily average temp	34 °C
b)	Min. daily average temp	11.7 °C
c)	Max. Ambient air temp. (daily)	34°C
d)	Max. Ambient air temp. (yearly)	30°C
e)	Max. Ambient air temp.	42°C
f)	Wet bulb temperature	28°C
g)	Design ambient temp. for all electrical equipment	50°C
h)	Wind Design	Basic Wind Speed, Vb = 39m/s

i)	Pollution Severity	Highly Polluted
j)	Seismic Criteria	III
k)	Relative Humidity	100%
l)	Average annual rainfall	750 mm

SITE PROFILE

Location	Wanakbori, District-Kheda, Gujarat
Access by – nearest railway station	Ahmedabad – Vadodara Main Broad Guage line, Sevaliya (8 KM)
Nearest Airport	Ahmedabad and Vadodara
Nearest sea port	Kandla
Access by Road	10KM from Godhra NH No.8; 02 KM from Balasinor-Sevaliya SH No.59
Major Towns / Cities	13KM from Balasinor and 10KM from Sevaliya
Availability of Land	Within existing Thermal Power Station
Latitude	22° -52'N
Longitude	73° -21'E
Altitude	80Meters from mean sea level for existing Units 70Meters from men sea level for 800MW Unit 8

3.2 EVACUATION OF POWER

For evacuation of power through outgoing line feeders, 400 KV transmission lines established by GETCO between the proposed power plant and exiting 400 KV substation of GETCO. The interface point between this switchyard and 400 KV transmission lines of GETCO will be at the take off gantry structures inside the switchyard fence.

Following title block shall be included in all documents for submission

3.4 SYSTEM PARAMETERS

Nominal system voltage	**400 kV**
Highest system voltage	420 kV
Rated lightning impulse withstand voltage	a) ± 1425 kVp between live terminals and earth. b) ± 1665 kVp impulse on one terminal and other terminal earthed (across isolating distance).
Rated one minute power Frequency withstand voltage	630kVrms
Rated switching impulse withstand voltage	1050 kVp (Phase to earth) 1575 kVp (Phase to Phase)
Corona extinction voltage	320 kV
Frequency	50 Hz
Rated short time withstand current capacity	40 kA for 3 sec
Creepage distance	31mm/kV
System Earthing	Effectively Earthed

3.5 AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of +3/-5% and variation in voltage +/-10%. For motors above 200W up to 160 KW. Fault level 50 KA symm.
1 phase A.C power supply	240V, 50 Hz, 1-phase, 2 wire, AC supply with variation in frequency of +/-5% and variation in voltage +/-10%. For motors up to 200W, Lighting, space heating, A. C. control & protective devices.
D.C. power supply	220V(variation from 190V to 240V) , 2-wire ungrounded 50V, 2 wire system (+) earthed. D.C. Supply Voltage : 187 to 242 Volt for 220VDC. For D.C. alarm, control & protective devices. Fault level 25* KA (Minimum) * Indicative only; the actual value will be decided by the bidder, after substantiating the same by calculation.
Combined variation of voltage and frequency for AC supply shall be +/- 10%	

3.6 GENERAL CONDITIONS

3.6.1 NAME PLATES (RATING PLATES)

Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name,

type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.
All trade nameplates and labels shall be in English language. All The size and location of nameplates shall be subject to approval of the Engineer.

3.6.3 Latent Defects:

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.8 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

3.8.1 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish
details of availability records in plants stated in his experience list.

3.8.2 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

3.8.3 Motorized lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings. No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating
covering hoist at outdoor shall be provided. Lifting devices like lifting tackles, slings, etc. to be

connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

3.8.4 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

3.9 MATERIALS

3.9.1 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.
All materials shall be new, and shall be of the quality most suited to the proposed application.

3.9.2 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application. All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

3.9.3 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

3.9.5 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

3.9.6 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

3.10 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India

should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing. As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:
a) Width of the Package: 3.2 Meters (from centre-line of rails- 1.6 meters on both sides)
b) Height of the package from rail top: 4.47 Meters

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorized and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge "and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.
Bidder to consider unloading of material delivered through rail transportation, at near by railway station/site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project
site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services if the Bidder. Bidder may consider entire material delivered up to site through rail transportation only. The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of
the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the
office placing the contract, nomenclature of contents and Bill of Material. For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

3.11 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts,

bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped. Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

3.12 PAINTING

3.12.1 GENERAL

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least
two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner. All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.
All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.
All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray
painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat. Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in
windy weather or near unprotected surfaces of a contrasting color and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment. Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use. Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior

factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting
instructions shall be furnished. Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C. The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

3.12.2 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying. Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed. The priming coat shall be applied without delay.

3.12.3 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

3.12.4 PAINTING SYSTEMS

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

a) Surfaces Subject To Weathering
All surfaces shall have a minimum of four coats of paint made up as follows:
Primer coat: 35 micron DFT
Tie coat: 35 micron DFT
Finishing coat (2 Nos.): 35 micron DFT per coat
The total minimum DFT shall be 140 micron.

b) Surfaces Inside Buildings
All surfaces shall have a minimum of three coats of paint made up as follows:
Primer coat : 35 micron DFT
Tie coat : 35 micron DFT
Finishing coat (2 Nos.) : 25 micron DFT per coat
The total minimum DFT shall be 120 micron.
The type and colour of primer & finish coat shall be selected by the
Contractor after approval by the Owner.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this

specification.

3.12.5 COLOUR CO-ORDINATION & FINISH

3.12.5.1 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

3.12.5.2 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

3.12.5.3 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

3.12.5.4 Final colours and finishes shall be to the Approval of the Engineer.

3.13 NOISE LEVEL REQUIREMENT

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

3.14 INSPECTION AND TESTING

3.14.01 Inspection and Tests during Manufacture

3.14.02 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

3.14.03 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

3.14.04 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

3.14.05 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable
notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results. The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the consultant for record purpose. Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library /record.

3.14.06 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

3.14.07 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to dispatch from place of manufacture.

3.14.08 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser as per Owner's approved QAP. The certificates shall include tests for mechanical properties and chemical analysis of representative
material.

3.14.09 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

3.14.10 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

3.14.11 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME

Boiler and
Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radio graphed.

3.14.12 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to
preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

3.15 PERFORMANCE TESTS AT SITE

3.15.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

3.15.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

3.15.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre commissioning to tests on completion and commissioning of the complete system/equipment.

3.15.04 For details of specific tests required on individual equipment refers to respective section of this specification

3.16 PACKING FOR SHIPMENT

3.16.01 The equipment complete with its accessories, spares, special tools and tackles shall be suitably protected by respective packing for shipment considering handling during transit, distance and weather conditions involved. The Contractor shall submit the packaging method for shipment to be adopted by him, if so desired by the Owner / Purchaser.

3.16.02 Each consignment shall be marked with Equipment name, Owner /Purchaser's name & address, Project details, handling instruction etc. It shall be complete with part list and identification details. The copies of the part list of each consignment shall also be furnished to the Owner / Purchaser after dispatch.

3.16.03 Equipment shall be packaged for transportation so as to meet the space and weight limitation of transport facilities. The contractor shall obtain approval from concerned authorities for transportation of over dimensioned consignment/package, if any, before starting manufacture of such equipment.

3.17 TYPE & RATING OF EQUIPMENT

3.17.01 The number of types and sizes of motor, controls, and other electrical equipment shall be kept to a minimum so that the requirement of spares is minimized.

3.17.02 Equipment shall be rated for the load and duty cycle of the intended service Circuit breakers and fuses shall be rated to withstand and interrupt the maximum fault current at the point of application in the circuit.

3.18 TROPICAL PROTECTION

3.19.01 All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

3.19.02 Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.20 ELECTRICAL SWITCH BOARDS

3.20.01 GENERAL

Switchboards shall be dead-front, free-standing, vertical, cubicle/panel type, completely wired, having access doors with concealed hinges and locking type latches.

3.20.02 Panels shall be fabricated from minimum 1.6mm thick for non-load bearing members & 2 mm thick for load bearing members, CRCA (cold rolled continuously annealed) sheet steel, free from any surface imperfections and suitably reinforced to provide a sturdy and rigid assembly. Load bearing wall/covers/back covers shall be 2 mm thick and for non-load bearing the wall/cover/back cover shall be 1.6 mm thick.

3.20.03 Panels shall be adequately sized for installation of field cables and access for maintenance. The working zone shall be limited between 300 mm and 1800mm from floor level.

3.20.04 Each panel shall be provided with internal illumination lamp operated by door switch, thermostat controlled space heater with miniature circuit breaker (MCB)unit, and plug socket with MCB for hand lamp.

3.20.05 Removable eye bolt/lifting lugs shall be furnished on all panels.

3.20.06 Unless otherwise stated, equipment rating and module sizes shall be as per annexure B. Module selection chart is specified for guidance of bidder in respect to requirement of module space and

component ratings.

3.21 EQUIPMENT MOUNTING

3.21.01 All instruments, switches etc. mounted on the front face of the panels shall be of flush type.

3.21.02 All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.

3.21.03 All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance. Adequate ventilation shall be provided in enclosed panel.

3.21.04 At least 20% with a minimum of one spare feeders of each type & rating shall be provided in MCC/Switch Board.

3.22 PANEL WIRING

3.22.01 All panels shall be fully wired at the factory to ensure proper functioning of all control, protection and interlock schemes. All wiring for external connections shall be brought to terminal blocks and numbered.

3.22.02 Panel wiring shall be carried out with flexible, 1100 grade, heat as well as fire resistance type PVC insulated stranded copper wire of minimum 2.5 Sq.mm(7/0.67mm) cross section.

3.22.03 Solder less compression/clamp type connection shall be used for wire terminals. Wiring shall be continuous between terminals without splicing. Each wire shall be identified at both ends with permanents markers having wire numbers as per approved wiring drawings.

3.22.04 All spare contacts of relays, aux. relays, contactors, aux. contactors, switches, push buttons etc. shall be terminated up-to external terminal block.

3.22.05 Terminal blocks shall be Box clamp type with marking strip. Not more than two wires shall be connected to one terminal. Spare terminal equal in number to 20% of active terminals shall be furnished.

3.23 GROUNDING

A copper ground bus for HT Switchgear and GI ground bus for LT boards, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid. Minimum size of ground bus shall be 75 X 10 sq. mm.

3.24 PAINTING

All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of epoxy based finish paint. The shades for different equipment shall be as follows:

a) For switchgears, MCCs, Distribution boards and other panels-Light Grey RAL 7032.
b) For transformer –Battle ship Grey shade 632 of IS-5.
c) For motors-Battle ship grey shade 632 of IS-5
d) For generator isolated phase Bus duct enclosure –Inside shall be Matt Black & outside will be light grey shade RAL 7032 for indoor part and battle ship gray shade 632 of IS-5 for outdoor. All supporting steel
structures shall be galvanised.HT and LT Bus duct shall be same as generator Bus duct.

3.25 NAME PLATE

Name plate of approved design shall be furnished on each panel and for each instrument or device mounted on panel. The material for name plate shall be 3 mm thick lamicoid or approved equal, with white letters on black background.

3.26 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

3.27 SPECIAL CABLES

Special cables for specific purpose, as required, shall be supplied and installed by the EPC Contractor.

3.28 CONDUITS

3.28.01 Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square, reamed, threaded and screwed tight at all joints.

3.28.02 Conduit entrances to pull boxes and switches shall have double lock nuts &insulating bushings. No running thread shall be used.

3.28.03 Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.

3.28.04 HDPE PVC pipes shall be used for single core power cables.

3.29 SPECIFIC REQUIREMENT - SERVICES (DESIGN & INSTALLATION)

3.29.01 Methods and Workmanship

3.29.02 All equipment shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

3.29.03 The erection work shall be supervised by competent supervisors holding relevant supervisory license

from the Government.

3.29.04 All details on installation shall be electrically and mechanically correct.

3.29.05 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

3.30 PROTECTION OF WORK

3.30.01 For protection of this work, the Contractor shall provide fencing and lighting arrangement, connect space heaters and provide heating arrangement as necessary or as directed by the Owner/Consultant.

3.31 ANNEXURE-B: MODULE SELECTION

MOTOR FEEDER

Type Motor Rating MCCB Rating Contactor Cable size
AU/AR 0 - 5.5 KW 32A 16A 3/c – 2.5 Sq.mm - Cu
BU/BR 5.6 - 11 KW 63A 32A 3/c - 16 Sq.mm - Al
CU 11.1 - 22 KW 63A 63A 3/c - 35 Sq.mm - Al
DU 22.1 - 50 KW 100A 100A 3/c - 95 Sq.mm - Al
EU 50.1 - 75 KW 200A 160A 3/c - 185 Sq.mm - Al
FU 75.1 - 110 KW 400A 300A 2 x 3/c - 185 Sq.mm - Al
NOTE :
1. MCCB with short circuit release, thermal overload relay with SPP feature, Contractor are to be co-ordinate (Type-2) with motor rating by the Contractor.
2. "U" stands for Undirectional and "R" for Reversible drives.

OUTGOING FEEDER

Type MCCB Rating Cable Size
AF 32A 4/c – 16 Sq.mm - Cu
BF 63A 4/c – 35 Sq.mm - Al
CF 100A 3.1/2 – 95 Sq.mm - Al
DF 200A 3.1/2 – 300 Sq.mm - Al
EF 400A 4 x 1/c – 630 Sq.mm - Al
Note: Cable sizes as indicated above are indicative. However EPC contractor shall submit the sizing calculation of cable and select the cable accordingly.

3.32 ANNEXURE-C: TECHNICAL PARAMETERS FOR ELECTRICAL SYSTEM

L.V. SYSTEM DATA

1	Nominal 3 phase voltage to be selected for L.V. system	415 V
2	Type of Breaker to be selected	Air break
3	Type of outgoing feeder switching device in L.T. MCC	MCCB

4	M.C.C. type	Single front/Double front Fully draw out type
5	Short circuit level for 1 sec	50 KA

DC. SYSTEM DATA

1	Nominal voltage to be selected for DC system	220 V
2	Type of Incoming / outgoing feeder switching device	Double pole Switch-Fuse
3	DCDB type	Single front/Double front Fully draw out type
4	Short circuit level for 1 sec	To be decided by Bidder 25 KA (minimum)

UPS SYSTEM DATA

1	Nominal voltage to be selected for UPS system	240 V, 1-Ph, 50 Hz, AC
2	Type of Incoming / outgoing feeder switching device	MCCB
3	UPSDB type	Single front, Fixed type, Modular construction
4	Short circuit level for 1 sec	To be decided by bidder 25 KA (minimum)

3.33 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.34 MATERIAL/WORKMANSHIP

3.34.01 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made

interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modem practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.
The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him. All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.34.02 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.34.02 COLOUR SCHEME AND CODES FOR PIPE SERVICE

All steel structures, plates etc shall be painted with non-corrosive plant on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.34.03 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other

damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.34.04 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.34.05 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be throughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for paintaing shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitabley wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 631 of IS:5.

3.34.06 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvasized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.34.07 PACKING

The following details are to be clearly indicated in the material forwarding documents:

a) Name and address of the consignee.
b) Purchase order number.
c) Name of supplier/s.
d) Description of equipment / material.
e) Net weight.
f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

3.34.08 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure

satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.34.09 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

a) Installed out door: IP-55

b) Installed indoor in air conditioned area: IP-31

c) Installed in covered area IP:52

d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41

e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.34.10 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided.

3.34.11 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.34.12 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm, copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal

boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publictions, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.34.13 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel or aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm cold rolled or 2.5mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project atleast 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.34.14 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments

3.35 DOCUMENTATION

3.35.01 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.35.02 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer,

name of consultant, the unit designation, GSECL contract no. , and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.35.03 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings.

Customer: Gujarat State Electricity Corporation Ltd.
Consultant: Development Consultants Pvt. Ltd., Kolkata
Project: 400kV Switchyard (extn.) & 400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

NOA NO.

3.35.04 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) Drawings
2) Guaranteed Technical Particulars
3) Type Test Reports
4) Manufacturing Quality Plan

3.35.05 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	10	13	-
2	Drawings "As Built "	-	-	13	05
3	Type Test Reports	1	05	13	-
4	Erection Manuals	-	11	13	-
5	Operation and Maintenance Manuals	-	11	13	-
6	Manufacturing Quality Plan	1	11	13	-
7	Field Quality Plan	1	11	13	-
8	Inspection Test Reports	-	-	13	-

Drawings will also be submitted in mini cartridges in AUTOCAD Release -2008 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

3.35.06 AS-BUILT DRAWINGS

The Contractor shall furnish drawings and document in as-built condition as stipulated in the specification.
On completion of the project, contractor should submit Three Sets of As commissioned drawings, Three Sets of as Installed Bill of Materials and Three Sets of As Commissioned Data/

Specification /Parameter Sheets Duly Signed by the Competent Authority.

3.35.07 DRAWINGS, DATA, INFORMATION AND MANUALS

3.35.08 Drawings, data, information & manuals shall be submitted as indicated below:

3.35.09 To be submitted after award of the Contract.

a) Single line diagram giving rating of each equipment.
b) Design calculations in support of selection of equipment rating and system design.
c) Technical Date sheets, characteristic curves.
d) Equipment layouts, layout of switchyard with sections.
e) Grounding & lightning protection drawings and details.
f) Cabling, cable trench and tray layouts with section and details with cable sizing calculation.
g) Dimensional general arrangement drawing along with cross- sections for equipment.
h) Foundation plan and loading data : design calculation and detail drawing of foundation.
i) Design calculation and detail drawing for civil work related to this specification.
j) Design calculation, GA drawing for GI structure and equipment supporting structure, and subsequently detailed drawings.
k) Mounting details of equipment and structure.
l) Fire fighting and sump arrangement.
m) Control & operation write up/Block logic diagrams.
n) Control schematic and wiring diagram.
o) Cable schedule and interconnection and cable routing.
p) Relay co-ordination.
q) Civil & structural analysis, design calculations and working drawings including bar bending schedule and fabrication.
r) Erection and maintenance manual.
s) Any other drawings & data as required for satisfactory installation, operation & maintenance.

3.35.10 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

(i) The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hardcopies.

(ii)The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

a) A complete inventory of all main items of plant, with identification details.

b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.

c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.

d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.

e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.

f) Manufacturer's literature.

(iii) The instruction manual shall be subject to the approval of Owner.

3.35.11 PLANT HANDBOOK

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the letter of award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms.

3.35.12 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVALPROCEDURE

(i) Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document. The documents shall be divided into two categories:

a) for approval and

b)for information/further engineering and co-ordination by the Owner.

In preparing this schedule, the Contractor shall allow four (4) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.

This document submission schedule shall require approval by the Owner/Engineer.

(ii) All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation. All dimensions shall be in metric units. All notes, markings etc. shall be in English.

(iii) Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/ information of the Owner/Engineer.

(iv) Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:

a) List of sub-vendors (from Owner only)

b) System scheme and instrumentation diagrams

c) Design basis justifying selection of equipment & process parameters where not specified in the Contract

d) Equipment data sheets and general arrangement drawings

e) Materials of construction

f) Layout drawings.

g) Operation logic diagrams.

h) Typical control circuit.

i) Drawings of Instrumentation and control.

(v) Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.

a) Equipment foundation drawings.

b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.

c) Predicted performance curves of equipment.

d) Various bills of quantity, schedules etc.

e) Piping fabrication drawings, isometrics etc.

f) Panel wiring diagrams.

g) Instruction/Operation manuals.

h) Service manuals and trouble shooting guide for C & I system including field instruments.

i) Cable schedule and interconnection chart.

j) Drive/feeder wise control scheme showing all external interfaces.

In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.

(vi) Upon review, the Owner/Engineer shall put his remarks and one of thefollowing action stamps on the drawing/document:

a) Approved.

b) Approved except as noted, forward final drawing

c) Approved except as noted, resubmission required.

d) Disapproved.

e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document. Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer.

The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements. The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

(vii) Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

(viii) For review by the Consulting Engineer, the Contractor shall furnish softcopies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorized revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

(ix) In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.

(x) For details of documentation for Civil, Structural and Architectural works, Vol.II-G may be referred.

3.36 QUALITY ASSURANCE

3.36.01 The Contractor shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserves the right to review the same and give his observations, if any, for compliance.

3.36.02 The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.

3.36.03 The Owner / Purchaser shall inform the Contractor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The contractor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.

3.36.04 Manufacturing and quality control procedures shall be available for audit to the Owner / Purchaser and/or its representative at the place of manufacture.

3.36.05 The Owner / Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

3.36.06 The Owner / Purchaser may inspect the Contractor's facilities prior to award of contract.

3.36.07 The Owner / Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.

3.36.08 The Owner / Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

3.36.01 QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorized representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following:

a) His organization structure for the management and implementation of the proposed quality assurance programme.

b) Documentation control system.

c) Qualification data for Bidder's key personnel.

d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

f) Control of non-conforming items and system for corrective actions.

g) Inspection and test procedure both for manufacture and all site related works.

h) Control of calibration and testing of measuring and testing equipments.

i) System for quality audit.

j) System for indication and appraisal of inspection status.

k) System for authorizing release of manufactured product to the Owner.

l) System for handling storage and delivery.

m) System for maintenance of records.

n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorized representative for approval. Schedule of finalization of such quality plans will be finalized before award.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final

testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organization, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorized representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/Authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorized representative for approval and dispositioning.

2.05.00 No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorized representative, and duly authorized for dispatch issuance of Material Dispatch Clearance Certificate (MDCC).

2.06.00 Materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report as per Owner's approved QAP. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/Sub-Contractor's works or at site shall be qualified as per ASME Section-IX orBS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorized representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for

approval.

2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalized with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalized and approved by the Owner/Authorized representative and form part of the Purchase Order between the Contractor and the Vendor.

2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalized with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject an equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.

2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.

2.14.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 QUALITY ASSURANCE DOCUMENTS

3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after dispatch of the equipment:

a) Material mill test reports on components as specified by the specification.

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

i) When some important repair work is involved to make the job acceptable.

ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalized specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Engineer, his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

4.02.00 The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/Inspector to issue such certificate shall not prevent the Contractor from proceeding with the works.

The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as maybe reasonably demanded by the Engineer/Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/Inspector or to his authorized representative to accomplish testing.

4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly &maintenance of the equipment. These special tools will also include special material handing equipment, jigs & fixtures for maintenance and calibration/re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for and the price of each tool/tackles shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with desiccator's packs as necessary.

2.01.02 Each spare part shall be clearly marked or labeled on the outside of the packing with the description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be

suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examinations may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be dispatched before the dispatch of the associated main equipment.

2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30years after commissioning of the plant.

2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is later. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.

2.02.00 Recommended Spares

2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalized after mutual discussion.

2.03.00 Start-up Commissioning Spares

2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection &commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor tonsure smooth commissioning of the plant shall be subject to the Engineer's approval.

2.03.02 The Contractor shall submit a complete list of all such start-up spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.

2.04.00 Mandatory Spare Parts

2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above. Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

2.04.02 Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The Bidder shall include in his proposal, on the basis of these guidelines, an item wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

2.04.03 The mandatory spares should be supplied to the Owner at least one month before the trial run. The dispatch programme is subject to approval of the Owner/Consultant after award of contract.

ANNEXURE-I

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company/ Contractor	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____ Contractor : _____			QP No. : _____ Date _____ Rev. No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

Note: All the information for QAP as stipulated above shall be finalized and agreed during contract execution.

ANNEXURE-II

FIELD WELDING SCHEDULE

PROJECT : FWS NO :

CONTRACTOR : REV NO. :

PACKAGE : FIELD WELDING CODE :

SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks

The Field Welding Schedule should be submitted for :

- Pressure Parts
- Tanks/Vessels
- Piping
- Heavy/Important Structural Steel
- Heat Exchangers
- Bus Ducts

Section-4

SCHEDULE-IIIC/24

400kV SWITCHYARD (OUTDOOR)

A. CIRCUIT BREAKER

Sl. No.	Item			Bidder's Response
1.	Name of Manufacturer		:	
2.	Manufacturer's designation		:	
3.	Reference standard		:	
4.	Type		:	
5.	Service		:	
6.	Pole	Nos.	:	
7.	Rated Voltage (Nominal/Max.)	KV	:	
8.	Frequency	Hz	:	
9.	Insulation Level			
9.1	Switching impulse withstand	kVp	:	
9.2	Impulse withstand	KVp	:	
9.3	One minute power frequency withstand	KV rms	:	
10.	Rated nominal current Amps at ambient temp.	°C	:	
11.	Derating factor for specified ambient temperature and site condition (if any)		:	
12	Temperature rise above 50°C ambient :-		:	
12.1	Rated current		:	
12.2	Short time current		:	
13.	Rated operating duty		:	
14.	Rated breaking capacity based on rated operating duty			
14.1	Symmetrical	KA rms	:	
14.2	D.C. Component	%	:	

Sl. No.	Item			Bidder's Response
14.3	Asymmetrical	KA rms	:	
15.	Restriking Voltage % Rated Capacity			
15.1	Amplitude factor		:	
15.2	Phase factor		:	
15.3	Natural frequency	KHz	:	
15.4	Rate of rise of restriking voltage V/uS		:	
16.	Rated making capacity	KA peak	:	
17.	Rated short time current for 3 secs. KA rms		:	
18.	Breaking capacity under phase opposition conditions KA rms		:	
19.	Capacitive Current Breaking			
19.1	Capacitive current	Amps	:	
19.2	Over voltage		:	
20.	Inductive Current Breaking			
20.1	Inductive current	Amp	:	
20.2	Over voltage		:	
21.	Total break time measured from the instant of trip circuit energisation			
21.1	At 10% breaking capacity	mS	:	
21.2	At 100% breaking capacity	mS	:	
22.	Arcing time			
22.1	At 10% breaking capacity	mS	:	
22.2	At 100% breaking capacity	mS	:	
23.	Total length of arc.	mm	:	
24.	Breaks per pole	No.	:	
25.	Length of break per pole	mm	:	

Sl. No.	Item		Bidder's Response
26.	Contact Travel		
26.1	Length of travel	mm :	
26.2	Rate of travel	M/S :	
27.	Make time	mS :	
28.	Spring charging time	Sec :	
29.	Reclosing time with rated control voltage applied and measured from the instant of trip coil energisation		
29.1	Minimum dead time for first auto reclose ...mS	:	
29.2	Range of adjustment for single auto reclose	mS :	
30.	Type of devices, if any, to limit the rate of restriking voltage	:	
31.	Short circuit type test certificate furnished ? Yes/No		
31.1	Certificate/Report	No. :	
31.2	Oscillogram	No. :	
32.	Contacts		
32.1	Type	:	
	a) Main	:	
	b) Arcing	:	
32.2	Material		
	a) Main	:	
	b) Arcing	:	
32.3	Whether the contacts are silver plated Yes/No	:	
32.4	Thickness of silver coating	mm :	
32.5	Contact pressure	Kg/Cm^2 :	

Sl. No.	Item		Bidder's Response
33.	Type of Arc control device	:	
34.	Whether main air column and interrupters are pressurised ?	:	
35.	Maximum pressure developed in the arcing chamber at rated breaking capacity Kg/Cm^2	:	
36.	Time limit for which the breaker can be kept open, if any	:	
37.	Auxiliary Contacts		
37.1	Total nos. of contacts furnished		
	a) Normally open Nos.	:	
	b) Normally closed Nos.	:	
37.2	Spare contacts available for interlocks in addition to those required for breaker's own operation and indication	:	
	a) Normally open Nos.	:	
	b) Normally closed Nos.	:	
37.3	Contact type convertible or fixed ?	:	
37.4	Contact Rating at 220VDC/240AC		
	a) Make and Continuous Amps	:	
	b) Break (Inductive) Amps	:	
38.	Permissible variation of 220V D.C.		
38.1	Closing	:	
38.2	Tripping	:	
39.	Permissible variation of working pressure of Breaker	:	
39.1	Closing	:	
39.2	Tripping	:	
40.	Air Consumption in litres (At NTP)	:	

Sl. No.	Item			Bidder's Response
40.1	Duty cycle (0-3 ' CO-3 ' CO)		:	
40.2	Closing		:	
40.3	Opening		:	
40.4	Total scavenging & leakage		:	
41.	Minimum blocking air pressure			
41.1	Closing	Ata	:	
41.2	Tripping		:	
42.	Minimum clearance			
42.1	Phase to ground	mm	:	
42.2	Phase to phase	mm	:	
43.	Arrangement provided for			
43.1	Pole discrepancy		:	
43.2	Trip free/Fixed trip		:	
43.3	Anti pumping		:	
44.	Operating mechanism		:	
45.	Power requirement at 220V D.C.			
45.1	Closing coil	Watt	:	
45.2	Tripping coil	Watt	:	
45.3	Spring charging motor	Watt	:	
46.	Type of interlocks furnished			
46.1			:	
46.2			:	
46.3			:	
46.4			:	
47.	Accessories			

Sl. No.	Item		Bidder's Response
47.1	Furnished as per Annexure? Yes /No	:	
47.2	If not, Deviation sheet duly filled up? Yes/No	:	
48.	Bushings		
48.1	Make	:	
48.2	Type	:	
48.3	Reference standard	:	
48.4	Voltage class KV	:	
48.5	Momentary dry withstand voltage KV	:	
48.6	Visible discharge voltage KV	:	
48.7	One minute dry withstand voltage KV	:	
48.8	One minute wet withstand voltage KV	:	
48.9	Impulse withstand voltage KV peak	:	
48.10	Under oil puncture voltage KV	:	
48.11	Creepage distance, total/ Protected mm	:	
48.12	Height required to remove the bushing mm	:	
48.13	Permissible safe cantilever loading on bushing	:	
49.	Nature of insulating medium of bushing	:	
50.	Volume of insulating medium of bushing	:	
51.	Overall dimensions of the circuit breaker complete with bushing, mechanism box etc. mm	:	
52.	Circuit Breaker Weight		
52.1	Total Weight Kg	:	
52.2	Impact for foundation design to include dead load plus impact value on opening at max. interrupting rating in dead load Kg	:	
53.	Shipping dimension of the largest package (L x B x H). mm	:	

Sl. No.	Item		Bidder's Response
54.	Shipping weight of the heaviest package	Kg :	
55.	The safety boundaries during breaking operation of circuit breaker with an external exhaust for ionising gases or flames in respect of air blast circuit breakers	:	
56.	First filling of oil furnished ?	:	
57.	10% excess oil in sealed non returnable container furnished ? If so, indicate the total quantity	:	
58.	Spare quantity of SF6 gas furnished ? If so, indicate the total quantity	:	
59.	Number of openings, the Circuit Breaker is capable of performing without inspection, replacement of contacts or other main parts.		
59.1	At 50% rated current	:	
59.2	At 100% rated current	:	
59.3	At 50% rated breaking capacity	:	
59.4	At 100% rated breaking capacity	:	
60.	Number of openings the Circuit Breaker is capable of performing without replacing/ reconditioning of oil:		
60.1	At 50% rated current	:	
60.2	At 100% rated current	:	
60.3	AT 50% rated breaking capacity	:	
60.4	At 100% rated breaking capacity	:	
61.	Air Compressor		
61.1	Type	:	
61.2	Make	:	
61.3	Capacity Litre	:	
61.4	Rated pressure Ata	:	
62.	Compressor Motor		

Sl. No.	Item			Bidder's Response
62.1	Type		:	
62.2	Make		:	
62.3	Rating	KW	:	
62.4	Voltage	Volt	:	
62.5	Phase	Nos	:	
62.6	Frequency	Hz	:	
62.7	Insulation Class		:	
62.8	Temperature rise above 45°C ambient temperature °C		:	
63.	Control and Measuring Panel			
63.1	Make		:	
63.2	Type of control		:	
63.3	Mounting		:	
63.4	Type and make of DOL Motor Starter with fuse switch		:	
63.5	Schematic diagram enclosed ?		:	

SECTION - 5

CHECK LIST FOR 420KV CIRCUIT BREAKERS

Put a tick mark (√) on 'YES' if the specified requirement is met, or put a tick mark on 'NO', if the specified requirement is not met and give comments in the "Remarks" column.

Sl. No.	Parameters	420 kV	YES/NO	Remarks
1	Type of Circuit Breaker	Outdoor, SF6	YES/NO	
1A	Class of Circuit Breaker			
	Mechanical endurance class	M1	YES/NO	
	Electrical endurance class	E1	YES/NO	
	Re strike probability class	C1	YES/NO	
1B	Electromagnetic Compatibility(EMC)	as per IS 12729 /IEC 60694 normal severity class	YES/NO	
2	Manufacturer's type designation			
3	Standard Applicable	IEC 62271 – 100,60694,IS-12729	YES/NO	
4	Rated Voltage (kV rms)	420	YES/NO	
5	Rated Current			
	Under normal condition (A)	2000 A	YES/NO	
6	Max fault level (3 s)	40 kA	YES/NO	
7	Phase to phase spacing	7000 mm		
8	Rated frequency (Hz)	50hz, +3% to -5%	YES/NO	
9	Number of poles	3	YES/NO	
10	Whether All The 3 poles ganged electrically or mechanically	Electrically	YES/NO	
11	Whether dead tank or live tank design	Live	YES/NO	
12	No. of break per pole		YES/NO	
13	Rated short circuit breaking current			
	i. Symmetrical component at highest system voltage (kA)	40	YES/NO	
	ii. DC Component (%)	as per IEC 62271-100	YES/NO	
14	Rated short circuit Making Current (kAp)	100	YES/NO	
15	Rated peak withstand current(kAp)	100	YES/NO	
16	Rated short time withstand current	40 KA for 3 sec	YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
17	Rated break time (ms)	i) 40 ms under test duties 2,3 &4 at rated voltages	YES/NO	
		ii) 45 ms under test duties 1 to 5 and short line fault test duties and combined variation of trip coil voltage, operating pressure and quenching media pressure , etc.	YES/NO	
18	Rated small inductive current Breaking capacity	Corresponding to interrupting steady and transient Breaking capacity magnetizing current of 50 to 630 MVA transformers with overvoltage less than 2.3 pu	YES/NO	
19	Out of phase breaking current	10 KA	YES/NO	
20	Out of phase making current	40 KA	YES/NO	
21	Rated line charging breaking current	400 A_{rms}	YES/NO	
22	Characteristic for short line fault related to rated short circuit breaking current	as per IEC 62271-100	YES/NO	
23	Rated capacitive switching breaking current/inrush making current		YES/NO	
24	TRV Characteristics	as per IEC 62271-100	YES/NO	
25	Total break time	-		
26	Closing time (ms)	< 100	YES/NO	
28	First pole to clear factor	1.3	YES/NO	
29	Short time current rating (kA) for 3s	40 kA	YES/NO	
30	Rated operating duty	O-0.3 Sec –CO -3 min –CO	YES/NO	
31	Out of phase breaking current	12.5 kA	YES/NO	
32	Maximum line charging breaking current with temporary over voltage upto 1.4 p.u. (A)	600A at 90° C leading power factor with maximum permissible switching overvoltage of 2.3 pu	YES/NO	
33	Maximum over voltage (p.u.) under any switching conditions	2.3	YES/NO	
34	Maximum pole discrepancy (ms)	Opening – 3.3 ms	YES/NO	
35	Small fault current breaking capacity (kAp)	As per IEC	YES/NO	
36	Maximum temperature rise for main contacts over design ambient temperature of 50°C	As per IEC	YES/NO	
37	Rated voltage & pick up range for trip coil (V)	220 V DC, Range – 70 % to 110 %	YES/NO	
38	Rated voltage & pick up range for closing coil (V)	220 V DC, Range 85 % to 110 %	YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
39	Reclosing	Single and three phase high speed auto reclosing	YES/NO	
40	Rated terminal load	As per IEC 62271-100 or calculated value which one is higher	YES/NO	
41	Temperature rise			
42	Design Ambient Temperature deg C	50	YES/NO	
43	Limit of temperature rise	Per IS/IEC duly adjusted for site condition	YES/NO	
31	**Dielectric withstand of complete Breaker**			
a)	One minute dry & wet power frequency withstand voltage			
	i. to earth and between poles (kV rms)	520	YES/NO	
	ii. across isolating distance (kV rms)	610	YES/NO	
b)	1.2/50- micro second impulse withstand test voltage			
	i. Between live terminals and ground (kVp)	±1425	YES/NO	
	ii. Between phases to CB open	±1425	YES/NO	
	iii. across isolating distance : (impulse on one terminal and other terminal earthed)	±1425(+240)* * Figures given in the bracket () are peak value of the power frequency to be applied to the opposite terminal (across isolating distance)	YES/NO	
c)	250/2500 micro second switching surge withstand test voltage			
	i. Between phase to earth (kVp)	±1050	YES/NO	
	ii. Between phases (kVp)	±1575	YES/NO	
	iii. Across isolating distance(kVp)	900 (+345) * * Figures given in the bracket () are peak value of the power frequency to be applied to the opposite terminal (across isolating distance)	YES/NO	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
d)	Corona extinction voltage (kV rms)	320	YES/NO	
e)	Maximum radio interference voltage for Frequency between 0.5 MHz and 2 MHz	1000 (max) at voltage 266 kV rms.	YES/NO	
f)	Total creepage distance		YES/NO	
	Minimum Creepage distance (@31 mm/KV)	13020 mm	YES/NO	
g)	Mounting	Hot Deep Galvanized Steel structure	YES/NO	
h)	Noise level at base	Maximum 140dB at base of circuit breaker	YES/NO	
i)	SF6 Gas	As per IEC 60376 & 61634	YES/NO	
j)	Anti pumping	Required	YES/NO	
32	**Pre-insertion resistor requirement**			
	Rating (ohms)			
	Minimum pre-insertion time (ms)			
	opening of PIR contacts			
33	**Operating Mechanism**			
	a) Type of operating mechanism for			
	i. Closing	1) Spring/Pneumatic/ Hydraulic or combination of these		
	ii. Opening	1) Spring/Pneumatic/ Hydraulic or combination of these		
34	**General**			
a)	Whether OGA drawing enclosed		YES/NO	
b)	Filled in GTP furnished		YES/NO	
d)	Interpole cabling included in Scope alongwith required Glands, Lugs etc.		YES	
e)	All Type Test Reports as per IEC 62271 – 100, not older than 5 years are available with bidder		YES	
f)	Bidder's unconditional acceptance of "Undertaking on Type Test Reports" –		YES	

Sl. No.	Parameters	420 kV	YES/NO	Remarks
	enclosed.			
g)	**Whether GI support structure included in Supply**		YES	
h)	**Whether foundation bolts for breakers and cabinets included in scope of supply**		YES	
i)	**No. of Aux. contacts per pole for purchaser's usage**	**14 NO + 14 NC**	**YES**	
j)	Min clearance in Air (mm) as per section-3			
	(i) Between Live Parts		YES/NO	
	(ii) Live Part to Earth		YES/NO	
	(iii) Live Part to ground with Support Structure / Stool		YES/NO	
k)	Control Cabinet –			
	Degree of Protection	IP 55 (Min.)	YES/NO	
	Type Tested for IP 55 within last 5 years		YES/NO	
l)	**Mandatory spares included in scope of supply as per section 1**		YES/NO	
m)	**Maintenance equipment common for all 420kV Circuit Breakers included in scope of supply as per section 1**		YES/NO	
n)	**Supervision of Erection, testing and commissioning included in scope**		YES/NO	